

# COMPUTER DIGEST

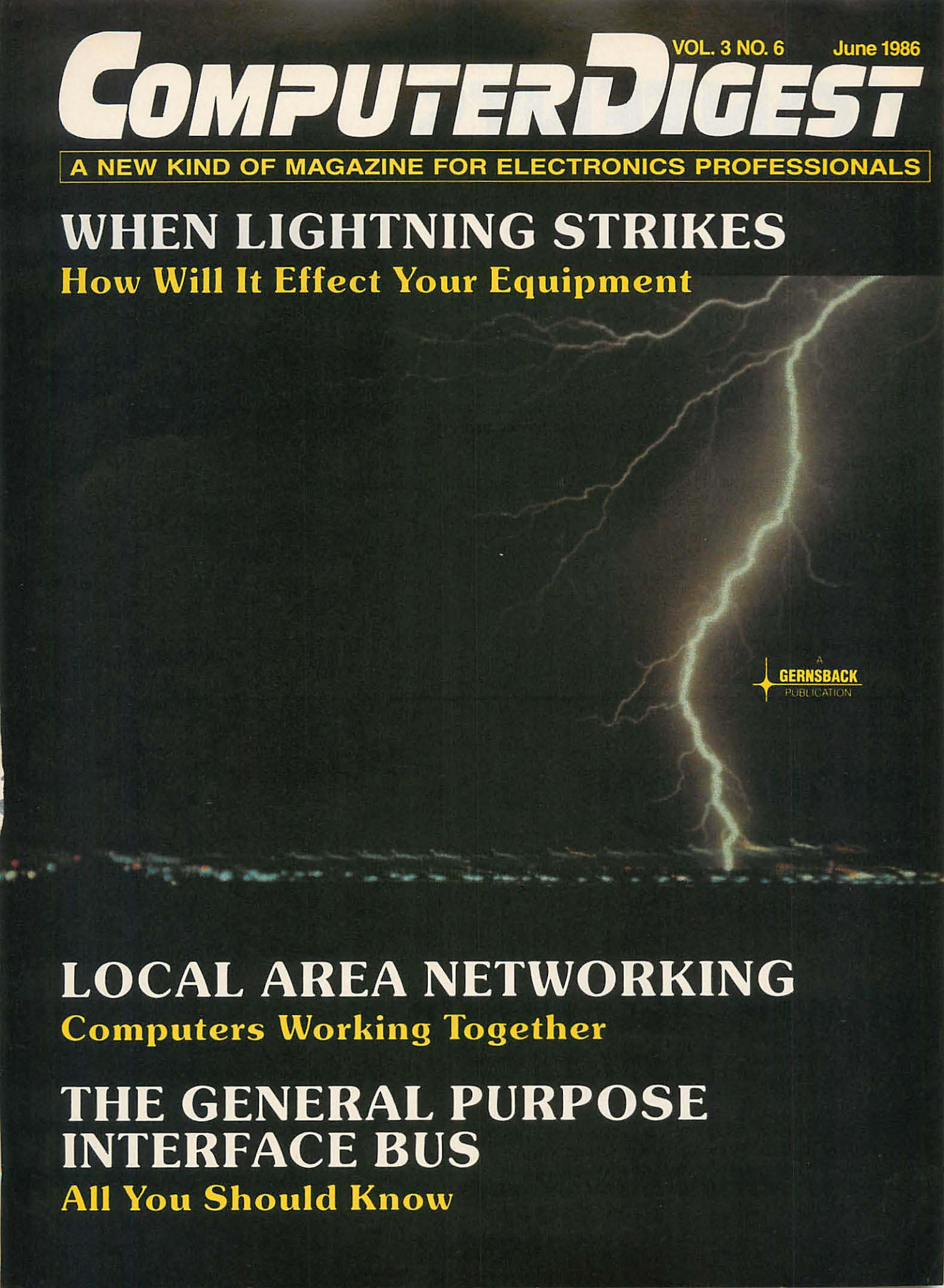
VOL. 3 NO. 6

June 1986

A NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

## WHEN LIGHTNING STRIKES

How Will It Effect Your Equipment



A  
GERNSBACK  
PUBLICATION

## LOCAL AREA NETWORKING

Computers Working Together

## THE GENERAL PURPOSE INTERFACE BUS

All You Should Know

# CONTENTS

Vol. 3 No. 6

June 1986

## 6 Local Area Networking

When you have to get a lot of computers handshaking, here's the basics of how and why. **Forrest Stone**

## 10 When Lightning Strikes

What can it mean to your computer and how can you protect against it? It happened to one of our authors! **Herb Friedman**

## 12 GPIB

If you don't know about the General Purpose Interface Bus, here's a chance to get caught up. **Marc Stern**

## 3 Editorial

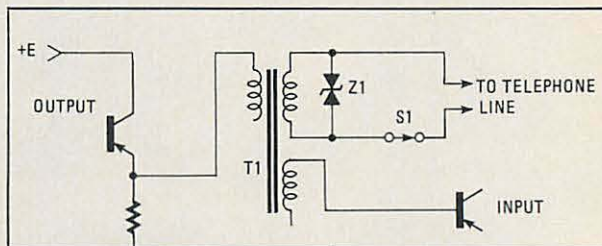
## 4 Letters

## 4 Computer Products

## 5 Software Review



See Page 6



See Page 10

## ON THE COVER

Lightning can put on a magnificent display but it has frightening overtones. Just how protective is the protective equipment you've installed? Is your system *really* as safe as you think it is? Our author relates a close call. See Page 10. (Photo courtesy approved lightning protection, Elmont, NY.)

## COMING NEXT MONTH

If you can't get your modem talking, you might just find the answer in this fact-filled article, More On Modems. And when you need an interface that will make things work together that weren't designed to, you might get some excellent use out of this Protocol Converter that we show you how to build. There's something new in Touch Screen Technology, called Surface Acoustic Wave, and we'll fill you in on that too. Of course, you'll find our usual mix of Computer Products, Software Review and Letters to the Editors. Don't miss it!

# EDITORIAL

## "If I give a man a fish..."

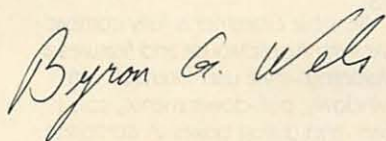
■He can have dinner. If I teach him *how* to fish, he can eat for the rest of his life."

A friend opened a school to teach computing at a commercial level. He made the courses available (with suitable grants) to the underprivileged, and envisioned hundreds, even thousands of graduates going out and earning salaries well-beyond their ken when they started the course. The students flocked to the school. To them, it represented an opportunity to learn a valuable skill at little or no outlay of cash.

But a strange thing happened. While many *began* the course, only few completed it! The first part of the course included typing, and this was followed by key punch. It was only after the student had mastered typing and key punch skills that he sat down to a computer keyboard. But very few were actually getting to the computer. They were taking the preliminary skills they had learned to market, and were getting jobs as typists or key punch operators. Certainly, the salaries they earned were not as great as a computer operator could command, but they were far in excess of what could have been earned in a factory as an unskilled laborer.

How many young men have dropped out of high school to take jobs as gas station attendants or truck drivers, because the minimal salaries offered sounded like manna to a single youth? How many have been lured into civil service positions with meagre incomes, eyeing the 20 year retirement? And how many of these could have led far-more prosperous lives, making a far-more meaningful contribution to society, had they but continued their educations?

A very-wise employer, early in my career cautioned me that "meagre security has been the downfall of many an otherwise good man." If you're a youngster, reading these words, please think twice, even three times before you bring your education to a halt. Raise your sights. There's no telling *what* might lay in store for you if you do.



Byron G. Wels  
Editor

ComputerDigest is published monthly as an insert in Radio-Electronics magazine by Gernsback Publications, Inc., 500-B Bi-County Blvd., Farmingdale, N.Y. 11735. Second-Class Postage Paid at New York, N.Y. and additional mailing offices. Copyright © 1986 Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

# COMPUTER DIGEST

M. Harvey Gernsback,  
editor-in-chief, emeritus

**Larry Steckler**, EHF, CET:  
publisher & editor in chief

**Art Kleiman**,  
editorial director

**Byron G. Wels**,  
editor

**Brian C. Fenton**,  
managing editor

**Carl Laron**,  
associate editor

**Robert A. Young**,  
assistant editor

**Ruby M. Yee**,  
production director

**Karen Tucker**,  
production advertising

**Robert A. W. Lowndes**,  
production associate

**Geoffrey S. Weil**,  
production assistant

**Andre Duzant**,  
technical illustrator

**Jacqueline P. Cheeseboro**,  
circulation director

**Arline R. Fishman**,  
advertising director

Computer Digest  
Gernsback Publications, Inc.  
Executive offices  
500-B Bi-County Blvd.,  
Farmingdale, NY 11735  
516-293-3000  
President: Larry Steckler  
Vice President: Cathy Steckler

## ADVERTISING SALES 516-293-3000

Larry Steckler  
Publisher

## NATIONAL SALES

Joe Shere  
1507 Bonnie Doone Terrace  
Corona Del Mar, CA 92625  
714-760-8967

# LETTERS

## Saving Copies

I'm sure we share a common problem. I tear out and save my **ComputerDigest** but have been wondering if you've found a better method than just stacking them? S. T., New York, NY.

Get what is called a "presentation folder" at any office-supply store. This consists of a clear plastic folder with a slide-on plastic backbone. If you cut the plastic folder right along the fold, you'll find that this setup neatly holds a full year's worth of the magazine.

## College bound

I'm going to be starting college shortly, with an eye to a career in

book or magazine editing. I'm sorry, but you are on my list of editors to write to for advice. What courses would you recommend that I take?—R. J., Bridgeport, CT.

R. J., you'll have to take the usual English lit and composition courses, as well as journalism courses. But do make it a point to get in some time on computer word processing! This will speed your output, make you more accurate, and it's the wave of the future.

## Computer "Heroes"

I've heard people involved deeply with computers described as everything from "nerds" to "eggheads." Considering that they've managed to accomplish so very much in this scientific field,

why aren't they given the recognition they deserve? —S.D., Atlanta, GA.

Next time you hear a computerist being put down, notice who's doing the putting down. It's probably some computer illiterate! Usually, it's just jealousy talking.

## More help

My very kind, well-meaning father bought me a Commodore Plus-4 from a TV ad. Can anybody direct me to some software—ANY software for the machine? And is there an expert on the hardware out there that I can get some answers from? Please PLEASE write to Jerry Sadofsky, 4839 Manderson, Omaha, NE 68104.

Hope this helps Jerry.

# COMPUTER PRODUCTS

For more details use the free information card inside the back cover



**PROOFREADING PROGRAM,** *Sensible Grammar*, is designed to check word-processing files for common writing errors. It goes beyond conventional proofreading programs that check the spelling of individual words, and uses its library of over 1000 commonly misused English phrases to identify pompous, informal, cliché, vague, wordy, repetitive, and other faulty phrases. *Sensible Grammar* also catches many punctuation, capitalization, and other typographical errors, such as repeated words. It

shows errors in context, automatically suggests replacement wordings, and lets the user immediately replace problem phrases with correct wording.

*Sensible Grammar* is fully compatible with AppleMouse and features a Macintosh-style user interface with windows, pull-down menus, scroll bars, and dialog boxes. A complete set of keyboard commands is also supplied for Apple II owners without a mouse. A 128K Apple IIe or IIc with 80-column display is needed.

*Sensible Grammar* is priced at \$99.95.—**Sensible Software, Inc.**, 210 S. Woodward, Suite 229, Birmingham, MI 48011.

**CIRCLE 7 ON FREE INFORMATION CARD.**

**TRANSPORTABLE PERSONAL COMPUTER,** the model A-200, exists in both mini floppy disk and hard-disk versions. It weighs 19 pounds, can be carried easily, and operates on AC. (A carrying bag is optional and makes for even easier portability.)

The unit includes a built-in foldaway, 80-column × 25-line text screen and

graphic liquid crystal display with a resolution of 640 × 200 pixels. By using an RGB monitor interface, a color monitor may be used when color graphics are desired. With a 512 kilobyte RAM (expandable to 640 kilobyte using an optional expansion box and



memory card) and two 5¼" 360-kilobyte disk drives, the user has access to a large memory capacity not usually available with portables.

The model A-200 is IBM PC compatible and also has an IBM-style keyboard layout; it has the capability for many software packages now available. The suggested retail price is \$2,295.00.—**Canon USA,**

**CIRCLE 8 ON FREE INFORMATION CARD.**

# SOFTWARE REVIEW

*Is there a "universal software?" No, but this comes close...*

■When the going gets tough: When the communications circuit is loaded with garbage: When the data must be exchanged absolutely error-free, or when at least one station must be unattended, the software of choice for PC and MS-DOS computers is often Crosstalk XVI. In fact, Crosstalk is the "standard of reference" to which much software is compared.

With few exceptions, all personal computer communications software can do both ASCII (direct keyboard entry and ASCII files) and protocol exchanges, but unlike much of the communications software, which is primarily intended for ease of operation when exchanging ASCII text with bulletin boards and information services, Crosstalk XVI is oriented towards convenient handling of error-free protocol exchange using an automodem.

Crosstalk's protocol exchange is done in blocks of 256K (or a multiple of 256K) which are checked at the destination for accuracy of reception. If the program senses an error the system will keep retransmitting (within limits) until it's received accurately.

The main power of Crosstalk is that the originating computer automatically controls the host (receiving) computer—there is no need to have anyone in attendance at the host. The originating computer can open and close the receiving computer's buffer, write to disk, read from disk, get a directory listing, and even control several DOS functions such as DIR, DELETE and COPY. In the protocol mode all functions and the data exchange are automatic, with the originating computer automatically controlling the write to disk at the host.

Just about every Crosstalk parameter is indicated on a status screen that can be instantly switched to a blank screen for data display of text or messages. Among the parameters shown are the telephone number of the receiving station, all the communication parameters such as baud rate, mode (originate or answer), the state of the capture buffer (on or off), the filter settings, and the automatic send control settings. The filter setting controls such things as automatic line feed after carriage return, filtering of all control characters, and automatic stripping of a received eight bit, etc.

The lower section of the status screen is either a library of lesser-used commands and functions, or a directory of "command files," which are basically saved status screens for individual computers and information services such as CompuServe, MCI, Dow Jones, etc. Status screens are automatically assigned a key number when saved to disk: Simply entering the indicated number loads the pre-set status screen conditions and automatically dials the telephone if you're using an automodem. (In the initial installation of Crosstalk a menu selects the proper modem commands for all commonly-used automodems, and some that are not so commonly used.)

Changes to the screen status can be made at any time by entering the first two letters of the function into a command line which runs across the bottom of the

screen. For example, to change from full to half duplex the user need type only DU (plex) on the command line. To select a specific key to function as the transmitted BREAK the user simply enters the command BR (eak) and presses the key he wants to use as the Break key. Similarly, the user can force the program into the originate or answer mode through the MO (de) command. A rather extensive help screen can be called up for any function by entering HELP and the first two letters of the function on the command line.

Although Crosstalk XVI is intended to run on 16-bit PC/MS-DOS computers, it can also do protocol exchanges with 8-bit CP/M computers that use the CP/M version of Crosstalk. Even if one computer is 8 bits, when serving as a host (answer mode) Crosstalk provides two levels of protection against unauthorized use or meddling with the disk files. The first is a password of up to 12 characters: If the correct password isn't given on the third try Crosstalk causes the modem to disconnect from the line. (Yes, the password protection can be disabled.) The second level of protection are file attributes. Through the host's status screen the originating station can be permitted to have full access to the system (including DELETE), read only, write data into an existing file ("capture data"), or append data to existing files or create new files.

Macros or commands can be programmed into the computer's function keys in three levels: Ten normal, ten shifted, and ten control. Function key F4 is an answerback which sends a user prepared string when polled by a Control-E from the receiving or host computer: It's the way in which many Telex and electronic mail services automatically determine the user's account number or identification.

A particularly advantageous feature is user programming of both the printer and modem parts on the status screen (so a particular configuration is saved in a command file). Crosstalk is not limited to COM1: for communications. If the printer is already connected to the computer through the COM1: serial port, Crosstalk can use COM2: for the modem, or vice versa. You arrange the printer and modem ports the way you want them.

To make the program "universal" Crosstalk also has the XMODEM protocols. The RXMODEM command tells Crosstalk to receive an XMODEM file transfer, the XXMODEM command tells Crosstalk to send a file using XMODEM protocols.

We have touched on only the major highlights of Crosstalk: Those that insure data integrity, which is what it's really all about. Although Crosstalk can be used with a manually switched modem, and like all other communications programs can be used for conventional ASCII exchange, it is really easiest to use in the automodem and protocol modes.

Crosstalk XVI is intended for PC/MS-DOS computers. For additional information write to Microstuf, 1000 Holcomb Woods Parkway, Roswell, GA 30076. 

# LAN— Local Area Networking

*How to get lots of computers handshaking—and why.*

## Forrest Stone

■Broadband! Baseband! Twisted Pair! Star! It's enough to confuse even the most dedicated computer hobbyist, but, Local Area Networking is the wave of the future for many people and these are some of the terms that a network user will be confronted with.

Local Area Networking has developed a terminology all its own. There are nodes and servers; tokens and CSMA/CD, and much more. What it really boils down to is a system of linking microcomputers into a shared network where each micro has access to the system's resources. (See, Fig. 1)

If this system sounds similar to the mainframe or minicomputer worlds with their linked terminals and shared system resources, it should. A microcomputer Local Area Network is a microcosm of a typical mainframe network. But, when you move to Local Area Networking in the microcomputer world you gain an added bonus, you retain the versatility of the microcomputer, while gaining the capability of a much larger system.

Think of your first microcomputer installation. If

you've been involved with this hobby long enough then it was probably a small eight-bit system whose storage device was a cassette recorder. The next big advance in this system was the move to a floppy disk and the addition of a printer. At each point, the system gained capability. Eventually, your eight-bit system probably gave way to a 16-bit system, which may even include a 5- or 10-megabyte hard disk, as well as color-graphics capability. Compared to your first system, this is a quantum leap in its capacity and flexibility.

For most single users, this type of system is more than adequate—you can move up to a high-speed, high-powered 32-bit processor, to stay at the cutting edge of technology, but for most single users, this type of processor is overkill—it can easily handle any chore. But, a funny thing has happened in the corporate environment. Users want to have access to the corporate mainframe or minicomputer, while retaining the off-line personal computing power of a microcomputer.

They want to use the data contained in various mainframe databases; or want access to the mass storage capability of the system, or, they may simply want to communicate with someone on an electronic mail system.

Whatever the reason, it's at this point that the single-user microcomputer system begins to show its



FIG. 1—3COM'S ETHERNET is a shared system with each micro sharing system resources.

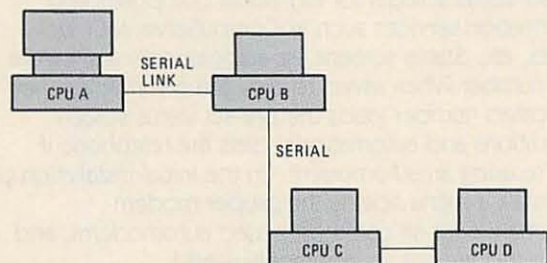


FIG. 2—THE SERIAL NETWORK looks eminently workable, but does have its problems.

inadequacy. Because of its standalone nature, the single-user system is effectively cut off from the rest of the corporate world, unless, of course, a communications modem is attached to a serial port. In that case, the micro can conceivably interact with others in the company. But this is inefficient because of the need for a telephone line on both ends. Effectively, this microcomputer can only interact with a remote, online database or with only one other corporate microcomputer.

### Search for solutions

When this point is reached in any corporation, microcomputer users begin to look for alternatives. The simplest and most obvious solution is a serial communications network, or linking the serial communications ports of all the microcomputers involved. While it appears feasible, this type of network has inherent problems. (See Fig. 2)

First, when you daisy-chain microcomputers into a serial network, the systems on the farthest end of the loop will find performance degraded, unless line amplifiers are included in the network. Further, the speed limit on this type of network is effectively constrained to about 9600 bits per second, providing of course, that the environment is clear of interference which can glitch data as it moves through. This puts an effective limit of between 4800 and 9600 baud on the network and while this may seem fast enough, when you move massive amounts of data from one point to another, you'll find this speed level limiting.

Second, the software needed to make this type of system work—a terminal or communications program—is still essentially for single use. Although some programs will allow you to set up microcomputers as mini-bulletin boards so that others can log on and interact with the information stored on disk, it is still essentially one user-one computer, whether it's remote or not. For example, if you turn your personal computer into a mini-bulletin board so others on the serial network can use the data you have stored on disk—provided the software will let you do this without a modem. And someone wants to log onto your computer. When he does, others are locked out until the job is finished because of the single-use nature of the software.

Finally, the very nature of a serial system imposes real threats to data integrity and transmission within the system because of a factor known as contention or the ability to remain in control of the network long enough to transmit, receive or manipulate data before you lose the system to another microcomputer's data and signal.

A serial system is truly contention-based. It's every user for himself and every data bit for itself. It's like a rush-hour intersection with a broken traffic light and no policeman to control traffic. Only those cars whose drivers push through will make it, timid drivers don't. And, when two aggressive drivers meet, there's the inevitable crackup. To bring this back to the computer realm, put microcomputers in place of the cars and change the intersection to the serial transmission system and you can see what's happening. Data from

the strongest microcomputers, usually at the center of the system, controls the system and weaker, peripheral systems must wait and wait.

And when two strong computers try to capture the system, their data usually crashes into one another and its integrity is gone.

### Enter the LAN

The obvious solution to this situation, then, is the Local Area Network. It allows users to share system resources and data, while, at the same time, allows users to retain the versatility and power of their personal computers.

In concept, the Local Area Network (LAN) is simple. It is a reliable version of the serial network we've already discussed. However, you'd think from all the jargon that's tossed around relating to LANs, that it was a mystic rite. It isn't, but it does take some explanation to demystify the jargon.

As you wade through the LAN jungle, it's easy to become confused by the seemingly endless variety of systems on the market. A wide variety of LANs does exist, but, they can be identified by their transmission technology, cabling or configuration.

For example, there is one type of LAN which uses PBX (Private Branch EXchange) technology to link all its members. The PBX has traditionally been used to link phones throughout a building and then onto the common carrier network.

Manufacturers of PBX-based systems, traditionally such companies as AT&T, Northern Telecom and ROLM, see the existing base of telephone wiring—twisted pair—installed in major buildings and hope to take advantage of it by using that wiring to link personal computers into local area networks. It is true that this presents a cost-effective way of handling cabling, but it does impose speed penalties. Because the data

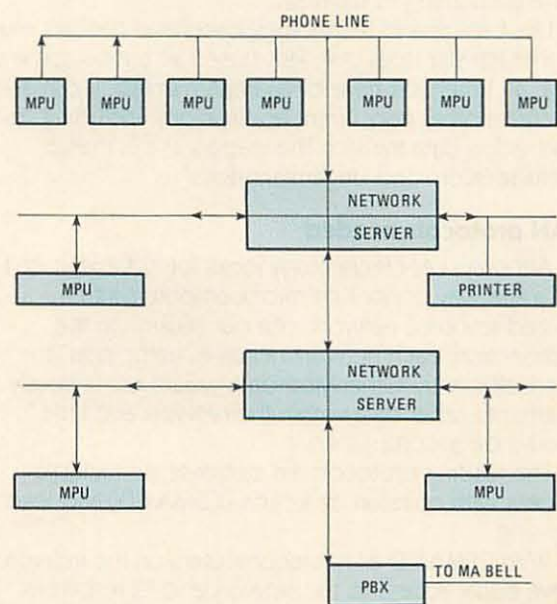


FIG. 3—SIMPLIFIED VIEW of a building's phone wiring and PBX LAN. System uses existing wiring and PBX loop to link CPU's and microcomputers. It has a high limit of 19.2 kilobaud.

transfer rate of PBX technology is only on the order of 9600- to 19,200-baud, it may not be high enough to handle massive amounts of speedy throughput. Data transfer rates on the order of 56K baud are needed to make this type of system effective and even that is a minimal figure in a fairly active network. (See Fig. 3)

When you move away from PBX-based LANs, you enter a realm which requires the installation of separate cabling systems to handle data transmission (even our mythical serial system requires a separate cable). The advantage of this type of LAN is that you can implement broadband or baseband technology.

In a broadbanded system, several discrete channels of information are transmitted on a single cable. It is a complex technology. A simpler solution is baseband technology. In a baseband system, there is only one channel per cable and you can effectively increase the data transmission rate beyond that of either PBX or broadband systems.

Typically, transmission rates in a broadbanded system—Interactive Systems/3M and Sytek offer them—are relatively slow on a per-channel basis at 19.2K- to 56K-baud, although they are much higher than on PBX-based systems. The real savings comes in cabling an installation. Several channels can be superimposed on a cable and because the several data transmissions can occur simultaneously, the amount of cable used in a system (most used coaxial cable) can be kept to a minimum.

Against this savings, there are increased costs for the installation in the form of extra equipment and costly maintenance. A broadband system requires the installation of an RF modem at each network node. These devices translate the analog signals used on the cable into digital signals so that they can be used by the microcomputers and other peripherals on the network. Further, this type of system is more costly and time-consuming to maintain.

Like broadband technology, baseband handles much higher transfer rates than PBX-based systems—some as high as 1 megabit have been implemented. It can also integrate other concurrent applications, including voice and video data transfer. The leaders in this market include 3Com and Ungermann-Bass.

### LAN protocols needed

Although LAN technology looks formidable, it isn't. It's just a way of hooking microcomputers into a shared-resource network. Like our allusion to the intersection, each network needs a "traffic cop" to work efficiently. Otherwise, data would continuously crash into other data within the network and little would be accomplished.

The leading protocols are carrier-sense multiple-access with collision detection (CSMA/CD) and token-passing.

With CSMA/CD all microcomputers on the network have equal access to the network and its resources. The software which drives this type of system continuously monitors data on the cable and keeps things in order. For example, if microcomputer A has accessed the system and is moving data to a file

server—an intelligent storage device such as a hard disk or a microcomputer equipped with a hard disk that is serving in data storage or transfer role—and microcomputer B wants to access the same server. In a CSMA/CD system, the software will determine which data has priority—actually which one accessed the system first—and will allow that data through. Data from microcomputer B will be held until the network is free for access. Typically, this is all transparent to the user.

In a token-passing scheme—advocated by Digital Equipment and Xerox in their Ethernet—the software polls each microcomputer node in turn asking if it must access the network. If the microcomputer is busy, it returns no answer and the system moves along to the next microcomputer. Polling is handled through the token, which is actually a coded sequence to which each microcomputer responds.

Like passing a baton in a foot race, each microcomputer that is accessing the system takes hold of the token when it arrives and this tells the network to accept its data. When the data is put on the system, the token is freed to pass to the next microcomputer. In this way, data retains its integrity and there is order within the system. It's much like a major highway control system with timed traffic lights. It allows orderly entry from side streets (microcomputers), while minimally disrupting overall traffic flow. And, it prevents collisions.

### Network configurations

As you deal with baseband LANs, you'll find three predominant configurations, the star, ring, and bus.

In the star configuration, the network is laid out similarly to the spokes of a wheel. Each microcomputer is at the end of a piece of cable that is, in turn, connected through a central switch. Data is sent to the switch where it waits until the network is free to accept it. Likewise, data which is being sent to each terminal waits at the switch until the terminal is ready to accept it. (See Fig. 4)

The ring network is a closed loop system, with each terminal along the perimeter of the system. Many of the ring systems on the market use the token protocol. (See Fig. 5)

The last configuration is the bus. In this type of installation the network is laid out as a backbone with each microcomputer at the end of a "rib." Information travels down the "ribs" and onto the main bus where it waits until it can be moved down the network. (See Fig. 6)

In all of this, there is a common theme, communication. Like our simple serial system, the LAN is simply a communications system which links and allows all the microcomputers connected to the network to have access to system resources. The typical configuration can be for as few as three machines or for as many as several hundred, depending on the needs of the organization. In a large system, a mainframe or minicomputer is usually used to drive the network. The network can be configured to use the storage capacity of the mainframe or mini,

although local storage can also be made available to various network nodes through file servers. Nodes are system devices such as microcomputers, servers, printers or modems. Any device capable of interfacing with a microcomputer can serve as a node.

File servers are microcomputers themselves. For

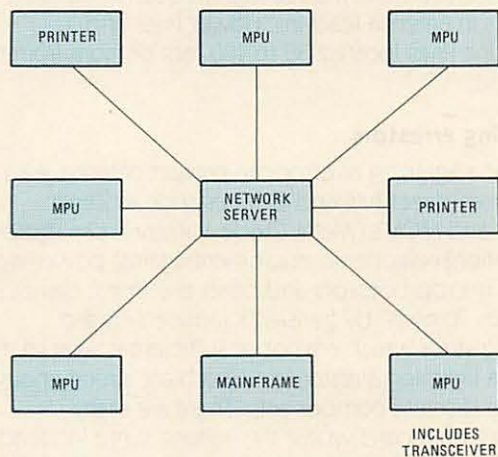


FIG. 4—SIMPLIFIED STAR configuration shows components arranged as the spokes of a wheel.

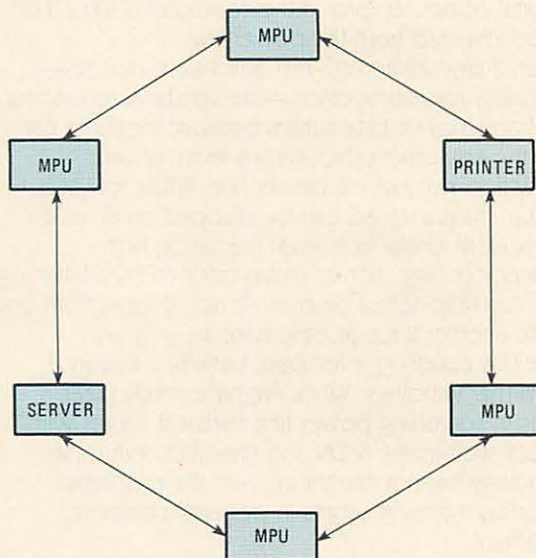


FIG. 5—THE RING CONFIGURATION connects all components in a circular fashion.

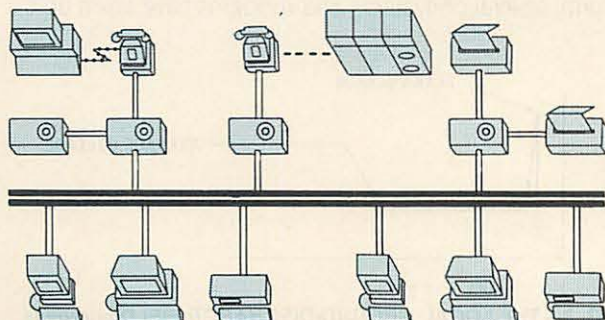


FIG. 6—THE BACKBONE LAN has "ribs" connected to a "spine." Components are connected to the ends of the "ribs" as shown.

example, a 3Com server uses an 80186 central processor with an 82582 Ethernet coprocessor. Included with this configuration is 512K of RAM. The processor, coprocessor and RAM are all included on one board. The server also includes a 36-megabyte hard disk with a 30 ms average access time. In its own right, it is a powerful computer system. In other systems, hard disks can have as much as 60 megabytes of storage. Many systems have three or more servers in their configuration, each of which interfaces not only with the microcomputers on the network, but also mainframes, if they are used to drive the system. To insure data backup and reliability, most systems also include tape backup systems.

LANs are more than just linking microcomputers. A LAN allows users to share system data and storage capacity, and printers, plotters and more. In fact, it makes sense in a network where a laser printer is used because each microcomputer user has access to its capability and it also helps justify the laser printer's cost.

### Software's the key

As you would expect, installing a LAN involves more than just linking microcomputers. In a typical 3Com system, each microcomputer has a network transceiver board installed on its motherboard. This transceiver is the link to the network and allows the microcomputer to interact with it. It is the mailbox to which data is sent and received. The cable is attached to it and it is the device which the network software talks to.

When a transceiver is ready to send data to the network, a special software code is generated. It is a query code and an announcement. The query segment polls the central system node to see if the LAN will accept data from the microcomputer. This "Here I Am" code packet is held until the network is ready to accept the data. When the system is ready, it answers the query code with an acknowledgement and the data is transferred to the system.

Each transceiver has its own special address code. This code enables the system to send data to a particular device or microcomputer and, likewise, it enables one microcomputer to send data to another via the network.

### Cable types

When you talk about LANs, the last thing that is usually mentioned is the type of cabling. In general, LANs use either coaxial or twisted pair technology. PBX-based systems usually use twisted pair—phone cabling—technology, while broadband or baseband systems use coaxial cable. This isn't to say that a baseband system can't use two-wire, twisted pair technology because it can. On the whole, coaxial, triaxial, too is used for most applications.

As you can see, the LAN will make a great contribution in areas where it makes sense to share resources and if you're involved in the switch to a LAN, there's only one thing to remember: its basis is network communications; the jargon used is secondary to its mission. ◀▶

# WHEN LIGHTNING STRIKES...

*Lightning strikes can be a problem for your computer.*

**Herb Friedman**

■ Before the age of electronics, the fear of lightning was not so much its immense electrical energy but the fire caused by the "hit" or "strike." Lightning protection meant some means of directing lightning to where it wanted to go—to ground. This was done by installing grounded metal rods—lightning rods—on top of houses, barns, windmills, whatever. The purpose was twofold. It grounded the energy and it conducted the energy around the structure.

With the electronic age, we inherited the worry of the electronic field produced by the strike. Very high fields are built up in the ground during an electrical storm. The ground field can track under a charged cloud and travel for miles before anything occurs. When the charge between the ground and the cloud

becomes sufficient the energies attract and we get the lightning strike. At the moment of strike there is an enormous discharge of ground energy, which creates a rapid expansion and collapse of a local electric field. Any collapsing or expanding field induces both current and voltage in wires. Although lightning might strike a tree in front of a house, the energy field produced during the strike can induce high frequency transient voltages in antenna lead-ins, power lines and telephone lines located 50 to 100 feet or more from the actual hit.

## Lightning arrestors

While a lightning arrestor can protect antenna lead-in wires from direct hits and devices such as Zener diodes and MOV's (Metal Oxide Varistors) can protect conventional electronic equipment against powerline surges, microprocessors and other electronic devices are often "blown" by transients induced by the lightning strike which are not of sufficient power to trigger a lightning arrestor, but which are strong enough to blow discrete components. There are many instances on record where the voltage surge induced in electric, telephone and antenna lead-in wires by a local lightning hit has been known to zip through the wiring and blow a TV tuner or the microprocessor of a personal computer, even if the computer is turned off or disconnected from the power line.

Even if disconnected? Yes! Solid state devices—particularly microprocessors—are sensitive to external high-frequency voltage surges because the surge can enter the equipment through any external wire connection, not just the power line. While low and medium frequency AC can be stopped by an open switch, an RF choke or a small reactance, high-frequency energy, such as that produced by a lightning strike, can leap across open switches, couple from one wire to another through otherwise insignificant capacitive coupling, even pass between insulated transformer windings. While we have made great strides in squashing power line transient surges with devices such as the MOV and gas-discharge tube, technology has not caught up with the problems caused by lightning surges in personal computer equipment.

For example, electrical storms are unusual in my locality, we get one or two every five years or so. Between the previous one and this year's electrical storm, several computers and modems have taken up

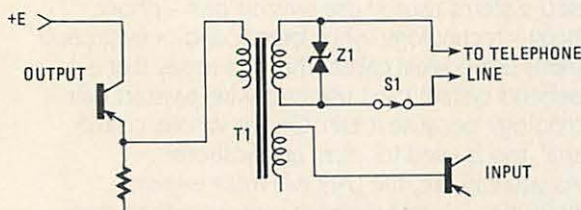


FIG. 1—THE BASIC ELEMENTS of a direct-connect modem's interface to the telephone line. Z1 is a surge suppressor that squashes transient voltages appearing across the line to approximately 50 volts. S1, which disconnects the modem from the line, is usually SPST.

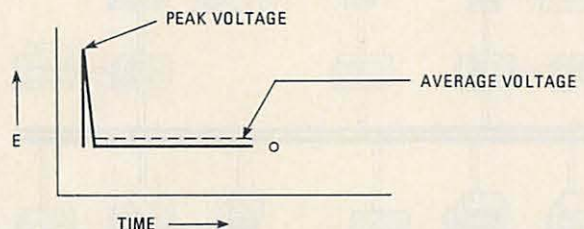


FIG. 2—THE LOCAL GROUND-DISCHARGE FIELD energy is almost an instantaneous rise and decay. This produces high-frequency energy through the upper VHF frequencies. In practical terms, it is high-voltage RFI.

residence in my home. In our most-recent electrical storm, lightning struck outside and disintegrated ten feet of curb. That was the only damage I thought, because my two computers were switched off, as were their modems. However, when I attempted to access an on-line information service, I discovered that both modems were blown, as was one computer's RS-232 driver (the one used for the modem). Coincidentally, the same storm passed through the area 20 miles away where my office is located, and lightning had struck the grounded radio/TV tower on the building.

Since my regular modems were inoperative, I borrowed the office modem which had been switched off during the storm, only to find that it too, was "blown."

### Interesting situation

Three modems of different design and manufacture had been blown during an electrical storm. All had some form of voltage surge protection, all had been switched off and one didn't even have a connection to the power line because it is powered directly from the phone line. A fourth modem, built into an IBM-PC which was connected on-line because it serves as a "host" for a voice message center, wasn't damaged at all!

### What to do

As near as we can determine, the three "blown" modems were damaged because of the way they were switched to the telephone line. Figure 1 is a simplified diagram of a direct-connect modem interface. Transformer T1 is the coupling transformer (repeat coil), Z1 is the telephone line overvoltage or surge-protection device, and S1 is a SPST switch that connects the modem to the telephone line. Normally, a voltage surge on the line is squashed by transient suppressor Z1, which might be a MOV, Zener diode, or gas-discharge tube. Usually, Z1 limits the surge to about 50 volts.

As shown in Figure 2, a voltage developed in the telephone line by a lightning strike in the general area

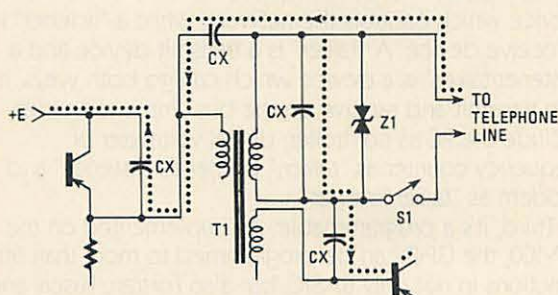


**FIG. 3—CAPACITOR "Cx" IS THE NORMAL** circuit capacity between transformer windings, solid-state device elements and component interconnecting wires. Cx is usually so small that it doesn't exist at audio frequencies but can represent a low impedance or "dead short" at the high frequencies of a lightning strike. When S1 is opened the lightning strike energy can follow the dotted path into the modem and eventually the high voltage bus where it is distributed throughout the modem, even to the modem's special driver.

will be a steep pulse. Although the average voltage—meaning the peak voltage averaged over a period of time—might be relatively low and safe, the peak value might be several hundred volts, and it is predominantly high frequency—extending well into the upper VHF range. High frequencies don't need a direct connection to pass from one wire to another. What is otherwise a minute capacity between wires and circuits, can appear to be "dead short" to high frequencies.

Imagine that the ground discharge of a lightning strike induces the transient waveform shown in Figure 2 on the telephone line connected to the modem circuit shown in Figure 3. Although S1 is open, disconnecting the modem from the telephone line, one wire is still connected to the line itself because almost all modems switch only one side of the telephone connection. We now have a high-frequency voltage surge on the telephone line which is looking for a path to ground. As shown by the dotted line in Figure 3, it finds the path to ground through the components in what we believe to be a disconnected modem. Notice that the energy represented by the dotted line flows through the capacity between T1's windings. The capacity might be very small, but it is there. To normal speech frequencies the capacity represents essentially an infinite impedance, but to the high frequency component of a lightning-caused transient surge the small capacity represents a low impedance, or even a "dead short," so the spike produced by the voltage surge passes through T1's secondary (telephone side) to the primary (modem side) to the modem's voltage supply bus. Now we have a high-voltage transient on what is usually a five- to nine-volt power bus. The result? ZAP!!! A fistful of blown IC's. If the surge is sufficiently high, it can ride through a blown IC in the modem and into the RS-232 driver, ZAPPING another handful of parts.

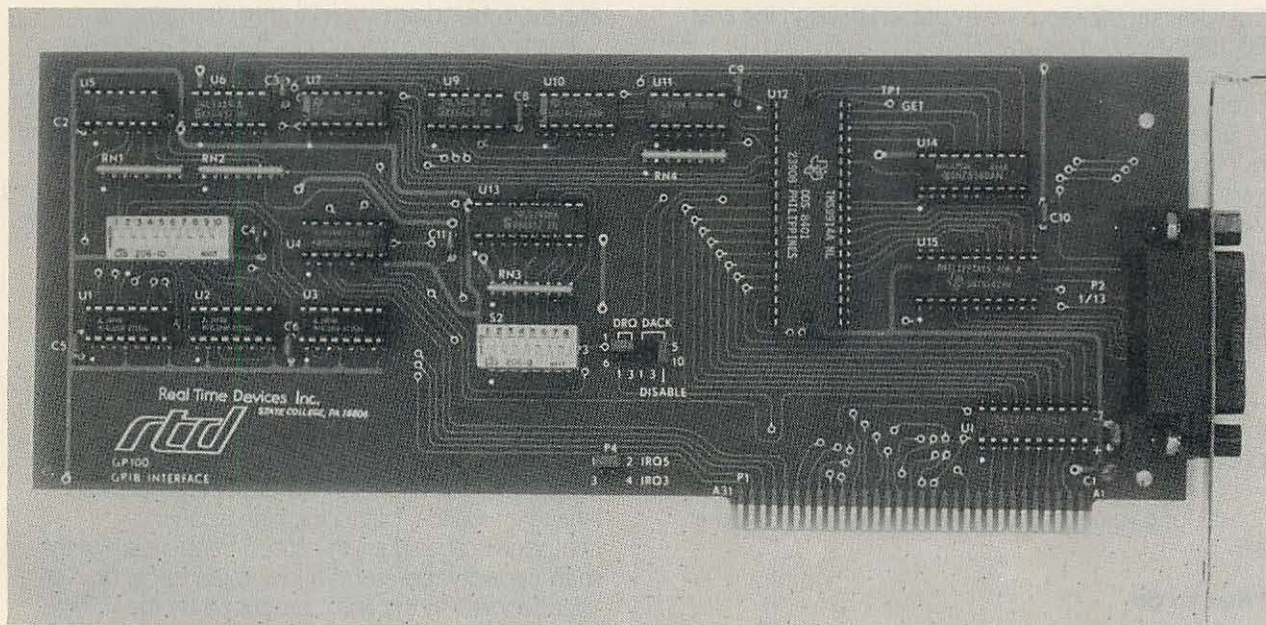
You might ask why Z1, the modem's internal transient suppressor(s) didn't stop the surge. Refer back to Figures 1 and 3. Z1 is connected across the telephone line: It is supposed to clamp surges appearing across the line, between both wires. But when switch S1 is opened to disconnect the modem from the telephone line, the transient suppressor has no effect on anything in the circuit. Z1 provides protection only when S1 is closed and the modem is connected to the line. This is probably why the direct-connect modem, connected on-line during the storm, wasn't damaged. Essentially, the risk of damage during an electric storm is increased when the modem is switched off the line.

### My "cure"

Most likely, modems should be manufactured with a double pole output switch so that both sides of the telephone line can be disconnected from the modem. Until such time as the manufacturers get around to changing their designs, I have installed a DPST knife switch on each telephone line to make certain the modems are really disconnected from the line. The inconvenience of "throwing the switch" is a lot less costly than the charges to repair or replace three modems and an RS-232 port. ◀▶

# GPIB

*The General-Purpose Interface Bus...*



REAL TIME DEVICES GPIB interface is shown here. It functions with all IBM PC and compatibles to expand the value of your computer.

## Marc Stern

■ If you look at your test bench, chances are you'll see the General Purpose Interface Bus (GPIB) connector. Also known as the HPIB (Hewlett-Packard Interface Bus), it's been around for some years and has become the standard for data acquisition.

GPIB was developed for tying one manufacturer's equipment together. But, because of the widespread use of that equipment in the scientific, test and measurement and repair arenas, it became standard. By the mid-1970s, it was formalized into the IEEE-488 standard. And even a computer giant such as IBM must use it rather than imposing its own.

Look at any modern test or measurement equipment that has a computer interface. You'll see it adheres to the IEEE-488 standard as to the size and shape of the connector, the construction, and the pinout.

Why not give your PC more function by having it interface with and act as part of your test equipment setup? It's easy to do, and, in fact, there are add-on boards on the market which will turn your PC into a machine capable of using the GPIB interface. One of the newer boards is from Real Time Devices of State College, PA. Other boards are available from the major add-on board manufacturers.

## GPIB Basics

Before we go any further, there are several basics to be established.

First, GPIB is a 24-line communications bus that is made up of three primary groupings, an eight-line data bus, a three-line data byte transfer control or handshaking bus and a five-line general interface management bus. The remaining eight lines are for signal ground and provide electronic shielding to prevent bus signals from interfering with one another.

Second, there are four types of devices which can be linked to the GPIB, a controller, "talker," "listener" and "listener/talker." As you'd expect, the controller is the device which controls the network, while a "listener" is a receive device. A "talker" is a transmit device and a "listener/talker" is a device which can go both ways. It can transmit and receive on the bus. Prime examples include the PC as controller; digital voltmeter or frequency counter as "talker;" printer as "listener," and modem as "talker/listener."

Third, it's a programmable. As implemented on the GP-100, the GPIB can be programmed to more than 50 functions in not only BASIC, but also Fortran, Pascal and Forth. And, as implemented, it becomes the major input-output (I/O) device on the PC in a test and measurement setting. It can also serve as a listener/talker if the network is controlled by still another computer.

Finally, the GPIB relies on direct memory access to the PC. In this way, the board and PC can communicate at 476 Kbytes per second and the systems can exchange up to a megabyte of data with a single

function call.

GPIB is a powerful tool, especially where huge amounts of data must be moved around a system quickly.

It can also be used in a more general atmosphere and can link up to 15 printers, plotters, modems or other devices into a small network.

Though the GPIB may seem a panacea, it isn't because, like the RS-232 "standard," IEEE-488 has been used differently by different manufacturers. So, it can be confusing to see a device advertised as adhering to the 488 standard, only to find out the device's lines are used differently. True, the connector may be the same and the lines may also be called the same, but, if a manufacturer implements them in its own way, then simply calling it standard won't make it so. Instead, you'll have to patiently debug the interface until it coincides with others.

Fortunately, most manufacturers adhere to IEEE-488 as does the GP-100, so you should have little trouble.

### High-speed data link

One of the items which made GPIB successful from the outset was its speed. The bus can potentially handle up to 1 megabyte of data per second, although data transfer rates of 1 to 10K are more common. With this type of throughput, it's possible to have real-time data input to a micro, mini or mainframe system, which is crucial in scientific, test and measurement of manufacturing applications. With this type of speed measurements can give real-time indications of what is happening and a system can quickly adjust.

For the technician, the GPIB's speed is attractive. With the PC interfaced with test equipment, you can have indications on the screen of what's happening in a part of a circuit and, as you change inputs, you can see how the rest of the circuit is affected.

Another reason for the success of this circuit is its configurability. Since 15 devices can be quickly attached and configured to work with the GPIB, a system's configuration can be adjusted to constantly-changing needs. If you need constant voltmeter and current readings from two points in a circuit and must also plot them. You can quickly add the needed devices to the circuit and you can record the results for future use. Plugging the new devices into the appropriate GPIB connectors should achieve this, provided, of course, the network adheres strictly to GPIB.

Since this bus is programmable, it is possible to transfer data directly from one device to another.

### Data's everywhere

The data which moves through the bus appears at all points simultaneously and there's a need to keep things in order. Imagine devices which have no need of the data accessing and using it along with the device for which it was intended. It's a waste of system resources.

Each device has an address and only when the controller sends a message to that address does the device react. Until then, it listens for its address to be accessed. For example, if the printer is at address 8

and you send output to the printer, the controller—IBM-PC in this case—puts an address 8 on the bus and the printer comes to life. Devices that aren't at this address ignore the information, even though it appears at their connectors.

There are two types of addresses, talk and listen. A device doesn't know what its next role will be or if it will take part in a function until it is addressed on the GPIB. The talk and listen addresses take care of that. For example, if a device sees its talk address then it knows it has to send data along the bus. A device which sees its listen address accessed knows it will have to accept data.

In action, the first piece of information a device receives is its listen address. This makes the device aware that it will be receiving information from the bus. Once it is listening, the controller can communicate with it, but, only after the computer-controller puts its talk address on the bus. In this way, the device knows which peripheral it will be communicating with.

Sometimes the device acting as the listener must indicate something to the controller, such as a paper jam or dead phone line and GPIB allows it. Of the 24 lines on the bus, only 8 are used for data, while the rest are reserved for grounding or special use. One of these is the Service Request line. It can be used by any device to indicate a problem has developed or a request must be made.

All the devices attached to the GPIB use the same SRQ line and since they do the controller must have a way of finding out which devices need attention.

There are three ways of handling this, the serial poll, in which each device is polled in turn by the controller; the parallel poll, in which all devices are polled concurrently, or the selective parallel poll, in which each data line is polled and once the line is found with the device that needs service, the controller polls all devices on that line serially.

### Bus lines

The GPIB has 24 conductors, whose functions can be thought of in three groups. (See Fig. 1)

The first eight lines of the interface are the data bus. These lines are used to transfer data from one point or device to another. Since there are eight lines associated with the data bus, it can transmit one digital word or byte at a time (eight bits).

The handshaking or data byte transfer control lines enable various devices to handshake with one another. Without this function, there would be no need for the data bus, since the devices couldn't "talk." A talker device must know when a listener is ready to accept the next data byte. The Not Ready For Data line supplies this information to the talker.

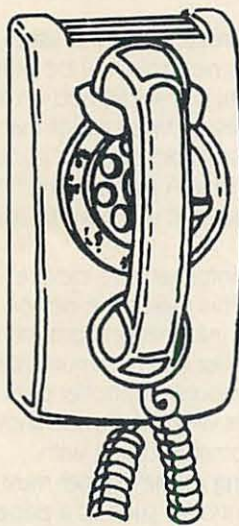
The Data Valid line tells the listener whether the information it is receiving is important or just noise. That line tells the receiver that the data is good.

The other part of the GPIB's handshaking is performed by the Not Data Accepted line which tells the talker whether the listener has accepted the data.

Ultimate control, though, is provided by the five general interface management lines: Interface Clear (IFC)

# R-E Computer Admart

Rates: Ads are 2 1/4" x 2 7/8". One insertion \$825. Six insertions \$800 each. Twelve insertions \$775. each. Closing date same as regular rate card. Send order with remittance to Computer Admart, Radio Electronics Magazine, 500-B Bi-County Blvd., Farmingdale, NY 11735. Direct telephone inquiries to Arline Fishman, area code-516-293-3000. Only 100% Computer ads are accepted for this Admart.



## CALL NOW AND RESERVE YOUR SPACE

- 6 x rate \$800.00 per each insertion.
- Reaches 229,044 readers.
- Fast reader service cycle.
- Short lead time for the placement of ads.

Call 516-293-3000 to reserve space. Ask for Arline Fishman. Limited number of pages available. Mail materials to: Computer Admart, RADIO-ELECTRONICS, 500-B Bi-County Blvd., Farmingdale, NY 11735.

### NEW TECHNICAL SOFTWARE

IBM-PC AND 100% COMPATIBLES  
LOW-COST • POWERFUL • ELEGANTLY  
SIMPLE

INTRODUCTORY PRICE — \$54.53 EACH

- 101-B EE1 - Solve most-used circuit equations fast. 128K COLOR OR MONO
- 106-B EE2 - 20 AC circuit programs, HF effects, etc. 128k, GRAPHICS
- 103-B PLOT - Plot equations. Vectors, Rectilinear, Polar, Simultaneous, Equation solver. BASICA, GRAPHICS
- 104-B MATH 1 - Parabolic dish design, Triangles, Straight lines, Factors, Progressions, more. 128k, GRAPHICS
- 105-B UNITS 1 - A Masterwork of units conversions, Systems of units, Constants, etc. 64K, COLOR OR MONO

PROWESS, INC., 203 Lakeridge Village,  
Suite 102, Dallas, Tx. 75238  
(214)-349-4718

CIRCLE 192 ON FREE INFORMATION CARD

### A Z-80 WORKSHOP MANUAL



Starting with a review of computer principles, this book describes typical machine-code instructions followed by a detailed description of the Z-80 instruction set. Assembly language programming is also discussed with examples. Z-80 hex machine-code and assembler instructions are given in tabular form, along with in-out connections for the Z-80 and its associated devices....Order your copy from **Electronic Technology Today Inc., PO Box 240, Massapequa Park, NY 11762. Price is \$6.95 plus \$1.00 for shipping.**

## CALL NOW AND RESERVE YOUR SPACE

- 6 x rate \$800.00 per each insertion.
- Reaches 229,044 readers.
- Fast reader service cycle.
- Short lead time for the placement of ads.

Call 516-293-3000 to reserve space. Ask for Arline Fishman. Limited number of pages available. Mail materials to: Computer Admart, RADIO-ELECTRONICS, 500-B Bi-County Blvd., Farmingdale, NY 11735.

is a reset; Attention (ATN) is a master bus command from the controller; SRQ is the special request line; Remote enable (REN) enables the controller to issue special commands to devices on the GPIB, finally End or Identify (EOI) is used as an end of message signal.

GPIB operates with a low-true logic convention. Because of the construction of this bus and the fact that everything is tied in in series, everything stays low until the last device in the series has accepted data. This means handshaking continues throughout the data transfer and waits for the slowest listener on the bus.

#### IBM interface

The GP-100 board and others use direct memory access, which speeds the data transfer process to and from the PC. For example, using input-output and handshaking routines and programming them results in a data transfer rate that will be below 100Kbytes per second. That is because the program must observe the handshaking protocol of the device with which it is

communicating. Direct memory access, however, allows the GPIB board to place commands directly in the PC's memory and thus communications can be speeded to 476 Kbytes per second. To implement this, you must know where the transfer will occur; the number of bytes, and whether the data will be input or output.

Boards such as the GP-100 can also issue interrupts to your PC so events that happen along the GPIB can be trapped and monitored as they are detected. The PC services the board and bus as soon as the interrupt is implemented.

GPIB has become a standard which began out of a company's desire to tie its equipment together with some order and certainty. It allows the technician to tie his PC in with his test equipment for a computerized testing system. In the future it will become a necessity as things get more complicated. By then, only a computer will be able to keep up. So, it's wise to start early and use GPIB to its fullest. ◀▶